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Title

Marked and widening socio-economic inequalities in type 2 diabetes prevalence in Scotland

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ABSTRACT

Background

This study investigated the association between socioeconomic status (SES) and type 2 diabetes (T2D) prevalence in Scotland in 2021 and tested the null hypothesis that inequalities had not changed since they were last described for 2001-2007.

Methods

Data from a national population-based diabetes database for 35-to-84-year-olds in Scotland for 2021 and mid-year population estimates for 2019 stratified by sex and fifths of the Scottish Index of Multiple Deprivation were used to calculate age-specific prevalence of T2D. Age-standardised prevalence was estimated using the European Standard Population with relative risks (RRs) compared between the most (Q1) and least (Q5) deprived fifths for each sex, and compared against similar estimates from 2001-2007.

Results

Complete data were available for 255,764 people (98.9%) with T2D. Age-standardised prevalence was lowest for women in Q5 (3.4%) and highest for men in Q1 (11.6%). RRs have increased from 2.00 (95% CI 1.52-2.62) in 2001-2007 to 2.48 (95% CI 2.43-2.53) in 2021 for women and from 1.58 (95% CI 1.20-2.07) in 2007 to 1.89 (95% CI 1.86-1.92) in 2021 for men.

Conclusions

Socioeconomic inequalities in T2D prevalence have widened between 2001-2007 and 2021. Further research is required to investigate potential medium-term effects of the COVID-19 pandemic.

SUMMARY BOX

What is already known on the subject?

The association between socioeconomic status and the prevalence of type 2 diabetes is well-established and the direction and magnitude differs between different countries. A strong inverse association between socioeconomic status and type 2 diabetes prevalence was last described in Scotland in 2007. Health inequalities in the United Kingdom have generally widened in the last decade.

What this study adds

Prevalence of type 2 diabetes in Scotland has increased in both sexes, all age groups and deprivation quintiles that were investigated, remaining higher in men and older people. Age-adjusted relative risks for the most compared to the least deprived quintiles for type 2 diabetes have increased for men and women between 2007 and 2021. Demands for diabetes care continue to increase and effective approaches to primary and secondary prevention of type 2 diabetes are needed to reduce health inequalities in type 2 diabetes prevalence in Scotland.

ETHICAL APPROVAL STATEMENT

Ethical approval was not required for this study. There was no individual patient data used, and there were no human or animal participants used in this study.

INTRODUCTION

The inverse association between socioeconomic status (SES) and type 2 diabetes prevalence in Scotland was last described using data for 2001-2007 [1]. A 2020 report showed that health inequalities in general have increased in the United Kingdom over the past decade [2]. Updated estimates of type 2 diabetes prevalence are needed to investigate whether socioeconomic inequalities in type 2 diabetes prevalence have changed over time.

METHODS

The Scottish Care Information – Diabetes (SCI-Diabetes) database provides population-based data for people in Scotland with a diagnosis of diabetes that is made by clinicians on the basis of blood glucose or glycated haemoglobin (HbA1c) measurements. It includes extensive clinical data that is updated in real time by daily downloads from primary and secondary care databases and includes data from all general practices in Scotland.

An area-based measure of socioeconomic deprivation can be assigned to individuals using their postcodes and the Scottish Index of Multiple Deprivation (SIMD). SIMD is based on a weighting and combination of 32 indicators across seven domains: income, employment, education, health, access to services, crime and housing to produce an index of multiple deprivation [3]. Quintiles of the SIMD score can be applied at a national level, with Q1 being used to describe the most deprived and Q5 used to describe the least deprived fifths of the population respectively. The 2016 version of SIMD was used for this analysis.

Aggregated data on numbers of people with diabetes for this project were obtained from SCI-Diabetes for people in Scotland with type 2 diabetes who were alive in February 2021 stratified into sex, five-year age groups and SIMD quintile. People who could not be assigned an SIMD quintile were excluded. Population data from the National Records of Scotland (NRS) in strata of age, sex and SIMD quintile for June 2019 were used as these were the most recently available data in the required format [4].

Crude prevalence of type 2 diabetes by SIMD and sex was estimated using the numbers of people with type 2 diabetes that were alive in February 2021 as the numerators, and population estimate as the denominators in five-year age groups.

The European Standard Population (ESP) for 35- to 84-year-olds was used to estimate the directly age-standardised prevalence of type 2 diabetes by sex and SIMD quintiles to control potential confounding by age. This age range was chosen to be comparable to that used for previous Scottish estimates. Poisson variance calculations were used to calculate standard errors for the data. Upper and lower 95% confidence intervals for prevalence were calculated by multiplying the standard error by 1.96 and adding or subtracting this number from the age-standardised prevalence.

Crude and age-adjusted relative risks were calculated using a ratio for Q1 to Q5 of the crude and age-adjusted prevalence of diabetes respectively, separately for men and women. Standard errors of the log rate ratios and the delta method were used to calculate 95% confidence intervals for these relative risks [5].

RESULTS

Data were available for 255,764 people with type 2 diabetes who were aged between 35 and 84 years who were alive in February 2021. SIMD could not be assigned for 1,224 women (1.11%) and 1,715 men (1.15%).

Crude prevalence of type 2 diabetes was higher in men than in women across all five quintiles of SIMD ($p < 0.001$ chi squared tests for all comparisons) and decreased consistently across quintiles from Q1 to Q5 for both men and women (see table 1 that also provides comparable data from the 2007 estimates). Overall age-specific prevalence of diabetes by sex in 2021 is shown in Figure 1. When further stratified by SIMD quintile age-specific prevalence among women varied from 0.5% in Q5 in 35–39-year-old to 17.2% in 80–84-year-olds. In men, age-specific prevalence varied from 0.8% in Q5 in 35–39-year-olds to 22.4% in Q2 in 75–79-year-olds.

Age-standardised prevalence of type 2 diabetes and 95% confidence limits by SIMD quintile and sex are shown in Figure 2. Prevalence of type 2 diabetes was higher in men than in women across all five quintiles of SES, and there was an inverse association between SES and prevalence of type 2 diabetes. The age-standardised prevalence was lower than the crude prevalence for all five SES quintiles for both men and women because of the differences in age distribution between the Scottish and European standard populations.

The age-adjusted relative risk for Q1 compared to Q5 was higher in women than it was in men. In women the ratio of prevalence of type 2 diabetes between Q1 and Q5 was 2.48 (95% CI 2.43-2.53), whereas in men it was 1.89 (95% CI 1.86-1.92). This compares to crude relative risks for Q1 compared to Q5 of 2.21 (95% CI 2.17-2.25) for women and 1.70 (95% CI 1.67-1.73) for men. This reflects the younger age on average among Q5 than Q1.

Table 1: Crude prevalence of type 2 diabetes in Scotland for people aged 35-84 years by SIMD quintile and sex for 2007 and 2021

Year	Sex	SIMD Quintile					RR (95% CI) for Q1 vs Q5
		1	2	3	4	5	
2007	Men	8.8%	8.0%	7.0%	6.3%	5.4%	1.58 (1.20-2.07)
	Women	7.0%	6.1%	5.1%	4.2%	3.3%	2.00 (1.52-2.62)
2021	Men	12.6%	11.6%	10.0%	8.6%	7.4%	1.89 (1.86-1.92)
	Women	9.5%	8.4%	6.7%	5.4%	4.3%	2.48 (2.43-2.53)

DISCUSSION

There is a strong inverse association between socioeconomic status and prevalence of type 2 diabetes in Scotland, which is more marked in women than in men. Diabetes prevalence increases with age and age confounds the association between SES and diabetes prevalence. Absolute risk of diabetes was higher in men than women and the relative risk associated with deprivation was higher in women than men.

Crude prevalence of type 2 diabetes has increased between 2007 and 2021 from 7.0% to 9.9% in men, and from 5.1% to 6.8% in women. Age-standardised prevalence of type 2 diabetes increased for both men and women across all five quintiles of SES in 2021 compared to data for 2001-2007. Age-adjusted relative risks for the most deprived to least deprived quintiles have increased over time from 2.00 (95% CI 1.52-2.62) in 2007 to 2.48 (95% CI 2.43-2.53) in 2021 for women, and from 1.58 (95% CI 1.20-2.07) in 2007 to 1.89 (95% CI 1.86-1.92) in 2021 for men. These findings suggest a widening of socioeconomic inequalities in diabetes prevalence, which is more marked in women.

A strength of this study was the use of data from a population-based diabetes register. Most people with a diagnosis of diabetes in Scotland were included, with only 1.1% of those excluded due not having SIMD assigned. Calculating age-standardised prevalence was another strength as it allowed for confounding by age to be controlled.

There are some limitations to this study. The most recent population data available were for June 2019, whereas the most recent data for type 2 diabetes were from February 2021. This may have led to some slight errors when calculating prevalence of type 2 diabetes. The increase in the size of the population in Scotland from June 2017 to June 2019 was 1.13%, so these errors would not be expected to have had a marked effect on the findings if the population changes from 2019 to 2021 were similar. The use of an area-based measure of SES rather than an individual one may mean that an individual's SES is mis-classified. However, the small population of 700-800 people included in data zones used to calculate SIMD mitigates this limitation. Changes in population distribution by SIMD quintile between 2019 and 2021 could also have affected prevalence estimates. It is not clear what effect the wider use of HbA1c to diagnose diabetes in recent years may have had on prevalence estimates.

Other studies from developed countries such as Sweden [6] and Spain [7] found similar associations between socioeconomic status and diabetes prevalence, including similar sex differences in the strength of the association. The Spanish study found that women living in neighbourhoods of SES had a 46% lower prevalence of diabetes compared to women living in neighbourhoods in the highest tercile of SES, and men living in neighbourhoods of the highest tercile had a 24% lower prevalence of diabetes. This compares to women in the least deprived quintile in Scotland in 2021 having a 55% lower prevalence of diabetes than women in the most deprived quintile, and men in the least deprived quintile having a 41% lower prevalence of diabetes than men in the most deprived quintile. SES was defined differently in these studies which means that these studies are not directly comparable, but the patterns are broadly similar.

In conclusion, there is a clear inverse association between socioeconomic status and prevalence of type 2 diabetes, which has grown stronger since the analysis of the 2001-2007 data. Effective approaches are required to reduce inequalities in key risk factors for diabetes including obesity. It will be important to evaluate the effect on inequalities of interventions to prevent diabetes such as those proposed in the Scottish government's Diabetes Framework for Prevention, Early Detection and Early Intervention [8]. A potential area for research would be to try and determine which SIMD indicators are the drivers of the health inequalities described in this work. Further research is required to describe the medium-term effects of the Covid-19 pandemic on inequalities in prevalence of diabetes.

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Figure legends

Figure 1 Age-specific prevalence of type 2 diabetes in Scotland 2021 by sex

Figure 2 Age-standardised prevalence of type 2 diabetes in Scotland 2021 by sex and Scottish Index of Multiple Deprivation quintile with 95% confidence limits



